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PATENT APPLICATION OF
HARRY W. SCHMIDT AND DAVID M. NEAL
ENTITLED
VIAL HANDLING SYSTEM WITH IMPROVED SAMPLE
EXTRACTION

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VIAL HANDLING SYSTEM WITH IMPROVED SAMPLE EXTRACTION

CROSS REFERENCE TO RELATED APPLICATIONS

5 This application claims the priority of
earlier filed co-pending provisional patent
application Nos. 60/188,665, filed March 11, 2000 and
entitled IMPROVED VIAL HANDLING SYSTEM; and
60/188,269 filed March 10, 2000 and entitled WATER
10 AND SOIL AUTOSAMPLER.

BACKGROUND OF THE INVENTION

 The present invention relates to vial
autosamplers of the type used for laboratory
15 automation. More specifically, the present invention
relates to sample extraction within the vial
autosampler.

 Vial autosamplers are used to automate
laboratory analyses associated with gas
20 chromatography, carbon measurement (total carbon and
total organic carbon) as well as other types of
analyses. Typically, a vial autosampler has a
storage area adapted to hold a number of vials to be
analyzed. A robotic system generally grasps one of
25 the vials and transports it from the storage area to
an analytical site. Once transported to the
analytical site, the vial contents are sampled and
the appropriate analysis is performed.

Autosamplers typically use separate sampling modules for extracting liquid and gas samples. One example of such an autosampler is described in U.S. Patent No. 5,948,360 to Rao et al. and assigned to Tekmar Company of Cincinnati, Ohio. Liquid sampling typically involves extracting a known quantity of liquid from the vial that is presented to the sampling module of the autosampler, adding a standard to the sample, and transferring the sample to an analytical device. Under certain situations, the specimen must be diluted by a technician by injecting the specimen with a specified volume of methanol or a water-based solution prior to sampling. The extracted sample or methanol extract is then diluted with water prior to analysis by the analytical device.

Gas headspace extraction generally involves injecting the specimen with a solvent, such as water, agitating the specimen, and purging the specimen with a gas. Some autosamplers are adapted to perform static headspace extraction while others are adapted to perform dynamic headspace extraction. In static headspace extraction, the specimen is purged from above the specimen and the headspace is removed and transferred to the analytical device. In dynamic headspace extraction, the specimen is purged from underneath the specimen and the head space is removed and then transferred to the analytical instrument. Autosamplers that are capable of performing the above

sample extraction include the Precept II and the 7000 HT autosamplers sold by Tekmar-Dohrmann, of Cincinnati, Ohio.

Since some sample extraction techniques, such as gas headspace extraction, involve bubbling a purge gas through the specimen, it is important to seal the vial to the needle during sample extraction. Ideally, an hermetic seal would be provided between the resilient vial septum and the needle sidewall. However, irregularities in both septum resiliency and needle sidewall surfaces can sometimes allow analytes to leak between the needle sidewall and the septum. Such leakage releases analytes and purge gas into the laboratory itself, and can reduce the sensitivity of the analysis. Thus, it is important for a laboratory device such as an autosampler to reduce or even eliminate analyte leakage during extraction.

SUMMARY OF THE INVENTION

A vial autosampler includes a sampling module with a sampling needle. The module is adapted to bring the sampling needle and a vial together such that the sampling needle pierces a septum on the vial. The autosampler also includes a sealing boot disposed about the sampling needle. The sealing boot engages the vial septum when the vial is fully engaged with the sample needle.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view of an illustrative automatic vial handling system with which embodiments of the present invention are
5 useful.

Fig. 2 is an elevation view of a portion of a vial autosampler illustrating an embodiment of the present invention.

Fig. 3 is a side elevation view of a vial
10 in an extraction position illustrating a sealing boot in accordance with an embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

15 Fig. 1 shows a perspective view of a vial autosampler device 10 in accordance with the invention. Device 10 includes a base unit 12 that includes a vial storage platform area 14, a sampling station 20, and a fluid handling system comprising
20 valves, glasswork, an other fluid handling components. Sampling station 20 receives a vial containing a specimen and extracts a fluid from the vial for further analysis. Finally, device 10 includes a central programmable control circuit that
25 accepts user inputs and controls the operation of device 10.

In operation, a vial is selected from vial storage area 14 and transported to an analytical site. The vial is generally positioned within a vial cup in

the sampling module, which lifts the vial such that a resilient septum, generally on top of the vial, is pierced by a stationary needle. Once the needle has pierced the septum, a sample is obtained. As
5 mentioned above, one way the sample can be obtained is by injecting a solvent such as water, and bubbling a purge gas through the specimen. As the purge gas passes through the specimen, analytes become entrained by the gas. The purge gas with entrained
10 analytes is recovered and analyzed in accordance with any suitable technique.

Fig. 2 is an elevation view of a portion of a vial autosampler illustrating an embodiment of the present invention. Fig. 2 illustrates vial 532 held
15 within vial cup 550. Vial cup 550 is coupled to an elevator mechanism that is adapted to raise vial cup 550 and vial 532. In operation, vial cup 550 lifts vial 532 to contact needle 556 for sample extraction. As vial 532 nears needle 556, vial 532 contacts
20 sealing boot 558 and seals with the end-cap 552 of vial 532. End-cap 552 includes a septum that is pierceable by needle 556. As vial 532 is elevated further, needle 556 pierces septum 554 thus allowing needle 556 to obtain a sample from within vial 532.
25 As needle 556 pierces septum 554, vial tab 568 raises against the urging of spring 551. As illustrated in Fig. 2, when a vial is not engaged with needle 556, sealing boot 558 is disposed about the bottom of

needle 556 thereby protecting both needle 556 and users from accidental contact.

Fig. 3 is an enlarged side elevation view illustrating sealing boot 558 in accordance with an embodiment of the present invention. Although embodiments of the invention are described with respect to a vial being moved onto a stationary needle, such embodiments are equally practicable with autosamplers that move a needle into a stationary vial.

Vial sealing boot 558, in accordance with an embodiment of the present invention, helps reduce analyte leakage during sampling. Vial sealing boot 558 is illustrated as part of an ejector mechanism, but can be provided separately. An ejector mechanism assists in the removal of needle 556 from vial 532 by providing a downward force upon vial 532 as vial 532 is lowered thereby countering the tendency of vial 532 to stick to needle 556 and lift away from cup 550. Vial sealing boot 558 preferably includes upper plate 560, lower plate 562, lower gasket 564, and upper gasket 566. As can be seen, upper and lower gaskets 560, 564 are disposed about needle 556 to the interface of needle 556 and septum 554. Preferably, upper and lower plates 560 and 562 are mounted relative to vial eject tab 568.

When vial cap 550 moves vial 532 into the fully raised position, sealing surface 570 on septum 554 bears against lower gasket 564 providing a seal

therewith. Additionally, upper seal 566 bears against, and seals with, upper sealing surface 572 on needle block 574. Thus, analytes that leak from the interface between the outer diameter of needle 556 and septum 554, will be trapped by lower gasket 564, upper gasket 566, and sealing surface 572. In this manner, analyte loss is reduced thereby increasing the efficiency of analysis.

Lower seal 564 and upper seal 566 are preferably constructed from a material that is chemically inert and thus is generally unaffected by contact with various analytes. One such example of a chemically inert material suitable for an embodiment of the present invention is silicone rubber. In order to select a sealing material that is suitably deformable, it is preferred that the hardness of the sealing material be selected to be between a range of about 30 to about 90 durometer D. Preferably, lower seal 564 and upper seal 566 are constructed from silicone rubber having a durometer of 40.

Although the present invention has been described with reference to preferred embodiments, workers skilled in the art will recognize that changes may be made in form and detail without departing from the spirit and scope of the invention.